

April 23, 1946.

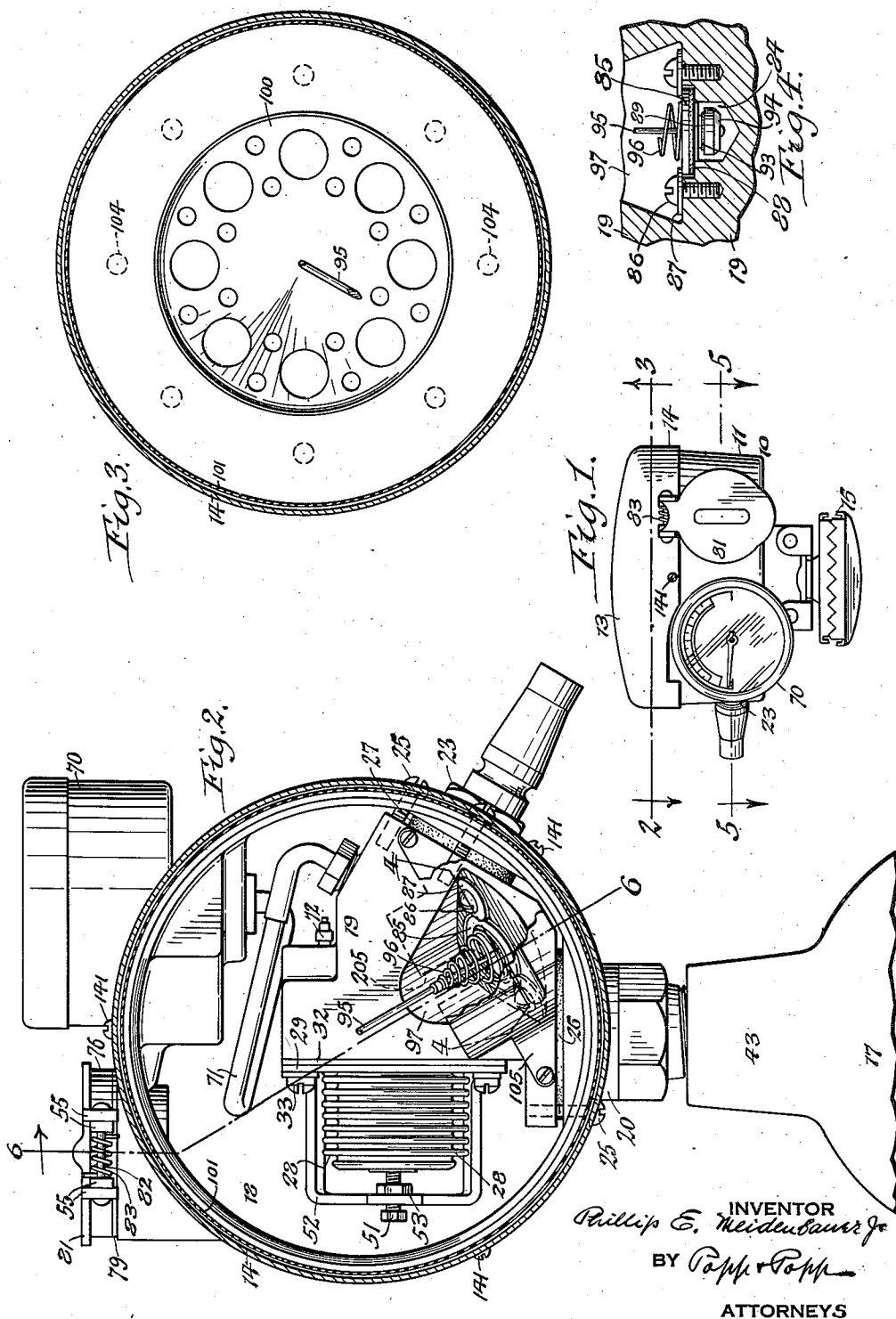
P. E. MEIDENBAUER, JR

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BREATHING APPARATUS

Filed Nov. 19, 1942

2 Sheets-Sheet 1



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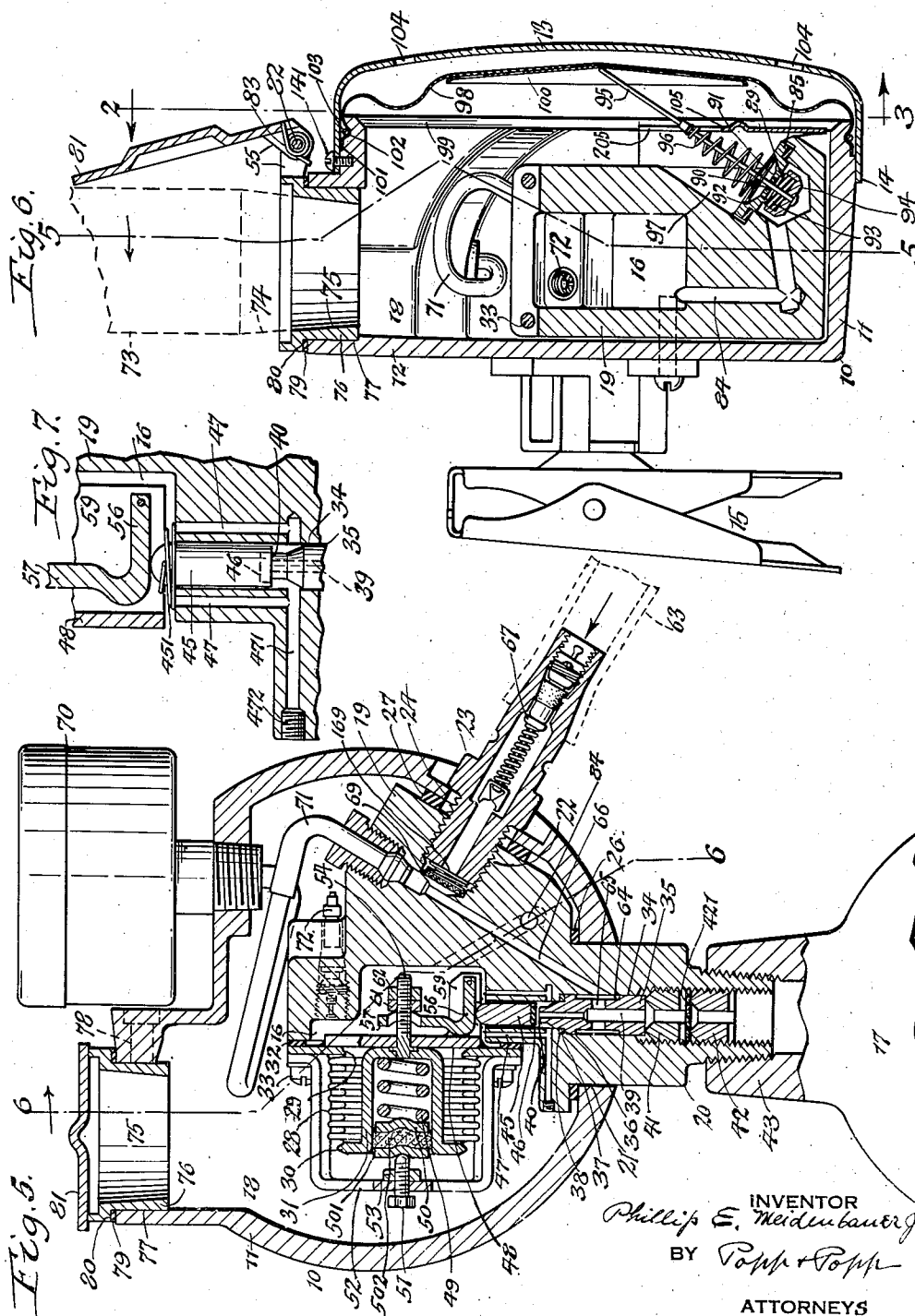
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2 Sheets-Sheet 2



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2,399,054

BREATHING APPARATUS

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Application November 19, 1942, Serial No. 466,165

5 Claims. (Cl. 222-3)

This invention relates to a breathing apparatus which is more particularly designed for use by aviators or aeronauts to supply oxygen when flying in high altitudes, but this apparatus may also be employed advantageously by miners, firemen and others for supplying oxygen or other life preserving fluid when operating in an atmosphere containing noxious or poisonous gases.

It is the object of this invention to provide an improved apparatus of this character in which the pressure of the oxygen at which it is supplied from a suitable source is first reduced by a pressure reducing valve mechanism to a pressure which can be more easily controlled and then delivered to the user by a gas demand valve mechanism which operates in response to the breathing action of the user.

A further object of this invention is to provide an instrument for accomplishing this purpose which is very compact in construction, reliable in operation and not liable to get out of order.

In the accompanying drawings:

Fig. 1 is a top plan view of this improved breathing apparatus, on a reduced scale.

Fig. 2 is a vertical transverse section of the same, on an enlarged scale, taken on lines 2-3, Figs. 1 and 6, looking rearwardly.

Fig. 3 is a similar view taken on the same line looking forwardly.

Fig. 4 is a fragmentary cross section of the demand valve mechanism taken generally on line 4-4, Fig. 2.

Fig. 5 is a vertical transverse section, on an enlarged scale, taken on lines 5-5, Figs. 1 and 6 looking rearwardly.

Fig. 6 is a vertical longitudinal section, taken on lines 6-6, Figs. 2 and 5, and showing the inlet of the delivery chamber closed and its outlet open.

Fig. 7 is a fragmentary vertical section, on an enlarged scale, of the pressure reducing valve and associated parts.

In the following description the reference numerals indicate corresponding parts in the several figures of the drawings.

The numeral 10 represents the main hollow enclosing case or housing of the apparatus upon which the various working elements of the apparatus are mounted and which preferably has the form of a cylinder the front side of which is open and comprises a cylindrical side wall 11, a flat rear wall 12 arranged at the rear edge of the side wall and formed integrally therewith by casting or otherwise, and a front wall 13 preferably

erably constructed of sheet metal and detachably connected with the respective part of the side wall by an annular flange 14 projecting rearwardly from the edge of the front wall and engaging with the cylindrical periphery of the side wall to which it is secured by screws 141.

Any suitable means may be employed for releasably mounting this body on the harness worn by the aviator such, for example, as the clip 15 attached to the rear wall of the body and adapted to grasp a belt or strap on the body of the aviator.

The space within the enclosing case is divided by a partition having the form of a body 19 into a receiving chamber 16 which receives the oxygen at low or reduced pressure from a high pressure source and a delivery chamber 18 into which the oxygen is transferred at atmospheric pressure from the receiving chamber and from which the oxygen is delivered to the aviator in accordance with his demand for the same. The receiving chamber is formed by a recess on the inner side of the partition body and the delivery chamber is formed between this body and the case.

The partition body may be variously constructed but, as shown in the drawings, the same consists of a block of metal 19 which is arranged within the case and has its lower end resting on the bottom thereof and one of its sides arranged adjacent to a side of this case. On its underside the partition body is provided with a neck 20 which projects downwardly through an opening 21 in the bottom of the case side wall and on its lateral side the same is provided with an internally threaded socket 22 into which the externally threaded inner end of a tubular body 23 of a replenishing check valve is screwed so as to project laterally therefrom through an opening 24 in the adjacent part of the case side wall. The partition body is secured firmly to the case side wall by screws 25 and airtight joints are produced between the same and the case wall by gaskets or soft washers 26, 27 surrounding the neck 20 and the valve body 23 and clamped between the respective parts of the case side wall and the partition body 19, as shown in Figs. 2 and 5.

The partition body 19 forms the stationary wall of the receiving chamber 16, the open inner side of which communicates with a flexible diaphragm bellows 28 which is capable of expanding and contracting. The inner end of this bellows is fixed and connected to a supporting ring 29 mounted on the partition body around the receiving chamber. The outer movable end of the bellows diaphragm is connected to an external

flange 30 formed at the outer end of a tubular plunger 31 arranged within the bellows. A gasket 32 is interposed between the supporting ring 29 and the partition body and these members are detachably connected with each other by screws 33.

Pressure reducing means are provided which are responsive to the movement of the bellows and permit oxygen stored in a portable container under relatively high pressure to enter the receiving chamber at a reduced pressure, which means are preferably constructed as follows:

The portable oxygen container has the form of a metal bottle 17 the upper end of which has a hollow neck 43 which is detachably connected with the neck 20 of the partition body by a screw joint. A supply passage 34 extends lengthwise through the partition neck from the bottle to the receiving chamber. In aviation the pressure in the bottle 17 or other source from which the receiving chamber 16 is supplied with oxygen may be five hundred pounds which is too high for direct use by the aviator and it is therefore necessary to reduce the pressure of the oxygen in the receiving chamber to, say, twenty pounds in order that it can be handled safely, conveniently and comfortably by the aviator. For this purpose a reducing valve mechanism is employed which includes a valve tube 35 arranged in the passage 34 and provided with an inwardly facing external shoulder 36 which bears against a gasket 37 interposed between this shoulder and an outwardly facing shoulder 38 in said passage and provided at its inner end with a valve seat 40 which surrounds the longitudinal port or passage 39 in the valve tube. The valve tube is held in place by a tubular clamping nut 41 screwed into the passage 34 and bearing against the outer end of the valve tube and a tubular lock nut 42 screwed into the passage and engaging with the outer end of the clamping nut 41, as shown in Fig. 5. Within the inner part of the passage 34 is arranged a longitudinally movable reducing valve or closure 45 the outer end of which is provided with a valve disk 46 adapted to engage with the seat 40 on the valve tube and the inner end of which projects into that part of the oxygen receiving chamber within the partition body. Upon moving the closure or reducing valve 45 inwardly away from the seat 40 the port 39 is uncovered and oxygen is permitted to flow from the bottle into the receiving chamber 16 and upon moving the valve outwardly and against the seat 40 the flow of oxygen is shut off. The valve 45 fits into the passage 34 loosely so as to permit the oxygen to flow past the same, and to prevent any oxygen in this passage from interfering with the free movement of this valve a relief passage is provided in the partition body which extends from the receiving chamber to the passage 34 adjacent to the outer end of the reducing valve, which relief passage preferably comprises two vertical sections 47 formed in the partition body 19 on opposite sides of the passage 34 and opening at their upper ends into the receiving chamber 16 and a horizontal section 471 formed in the partition body and having its inner part communicating with the lower ends of the vertical sections 47 and the valve passage 34 adjacent to the lower end of the valves 45 and having its outer end closed by a screw plug 472, as shown in Figs. 5 and 7. The reducing valve is yieldingly moved upwardly into an open position in which it uncovers the port 39 by a spring 451 which is preferably of spiral form and rests at one end on the bottom of the receiving

chamber 16, while its opposite end is connected with the upper end of the reducing valve, as best shown in Fig. 7.

The numeral 48 represents a vertical supporting bar which is secured to the ring 29 so as to extend across the opening in the latter and thus maintain communication between the receiving chamber 16 in the partition and the interior of the bellows. The inward movement of the plunger 31 is limited by engagement of its inner end with the outer side of the supporting bar 48 which acts as a stop for this purpose, as shown in Fig. 5. The plunger is moved inwardly and held yieldingly in engagement with the supporting bar 48 by adjustable spring means which in their preferred form are constructed as follows:

The numeral 49 represents a helical spring arranged in the plunger and bearing with its inner end against the inner end or closed bottom of the same. The outer end of this spring is backed up by adjusting and cushioning means which preferably comprise an inner follower 50 engaging the outer end of the spring 49, an outer follower 501 bearing against the inner end of an adjusting screw 51, and a cushion 502 of leather or the like interposed between these followers. The adjusting screw 51 works in a threaded opening formed in the central part of a supporting bracket 52 of U-shape which is secured to the inner bellows ring 29 by the same screws 33 which connect this ring to the partition body 19, as shown in Figs. 2 and 5. Upon turning this screw in one direction the spring 49 will be strengthened and require greater gas pressure within the bellows to expand the same outwardly, while turning of this screw in the opposite direction this spring will be weakened and require less gas pressure inside the bellows to expand the same. After the resistance of the spring 49 has been adjusted the screw 51 is held against turning by a jam nut 53 on this screw and bearing against the adjacent part of the bracket 52. The cushion 502 prevents vibration of the apparatus from affecting the adjustment of the spring 49.

The numeral 54 represents a shifting rod passing through a guide opening in the supporting bar and secured at its outer end to the inner end of the plunger while its inner end is arranged within the receiving chamber 16. Within the latter is arranged an L-shaped lever which turns in a vertical plane and has a lower horizontal arm 56 bearing against the upper end of the valve 45 and an upper vertical arm 57 provided with an opening through which the shifting rod 54 passes. The lower arm 56 is arranged between two lugs 59 projecting inwardly from the lower part of the vertical bar 48 and is pivoted thereto and the upper arm 57 bears with its inner side against an adjustable bearing screw nut 61 which is held in its adjusted position on the shifting rod 54 by a jam screw nut 62.

Whenever the bellows 28 is expanded by the pressure of the gas within the receiving chamber 16, the shifting rod 54 rocks the L-shaped lever 56, 57 outwardly, whereby the lower arm of this lever forces the valve 45 against the seat 40 and prevents the further flow of oxygen gas from the bottle 17 or other source of supply into the receiving chamber. When the pressure of the fluid in the receiving chamber 16 drops to a predetermined pressure the spring 49 contacts the bellows and rocks the L-shaped lever inwardly thereby permitting the valve 45 to be opened, as shown in Fig. 5, by the pressure of the spring 451 and

enabling further fluid to pass from this supply source into the receiving chamber.

By increasing the compression on the bellows spring 49 it will require a higher pressure of fluid in the receiving chamber 16 before the reducing valve 45 will be closed and upon decreasing the compression of this spring the reducing valve 45 will close when a lower fluid pressure has been reached in the receiving chamber 16. For the purpose of preventing any dirt or solid particles from passing from the container 17 to the receiving chamber separating means are provided consisting preferably of a screen 421 which is secured between the tubular screw nuts 41 and 42 and whereby any dirt or the like carried by the oxygen in the bottle 17 is intercepted and prevented from being inhaled by the aviator.

Replenishing means are provided whereby the bottle 17 and the fluid receiving chamber 16 may be replenished from an oxygen tank or other main source in which a comparatively large volume of this fluid is stored and transferred in smaller batches to this breathing apparatus for delivery at the proper pressure to the aviator as required. These replenishing means in the preferred construction shown in the drawings are organized as follows:

When replenishing of the supply of oxygen to the receiving chamber 16 from a main supply becomes necessary or desirable the outer end of the valve body 23 is temporarily connected by a supply hose 63 or the like with a tank in which a large volume of this gas is stored which gas flows through a longitudinal passage in this valve body to the longitudinal passage 39 in the reducing valve tube 35 by a transfer conduit consisting of an annular passage 64 formed on the periphery of the valve tube 35 within the opening 34 of the neck 20 and communicating with the longitudinal passage 39 of the valve tube by a plurality of radial openings 65 in this tube, and an inclined passage 66 formed in the partition body 19 and extending from the inner end of the replenishing valve body 23 to the annular passage 64, as shown in Fig. 5.

Within the check valve body 23 is arranged a check valve 67 of any suitable construction, such, for example, as that commonly used in the filling nipples of pneumatic tires for automobile wheels, whereby gas under pressure is permitted to flow forwardly from the main supply tank through the passages formed respectively in the replenishing valve body, the partition body and the valve tube 35 to the outlet at the upper end of the latter and to the neck of the bottle 17, but backward flow of this gas through the replenishing valve body is prevented. It is therefore possible by these means to transfer gas from the main storage tank to the bottle and to the passage or port leading to the receiving chamber 16 by merely attaching the hose 63 to the outer end of the valve body 23 and maintaining such connection until the desired amount of gas has been admitted to the bottle and the passages connected therewith after which the hose 63 is detached from the valve body 23, whereby the transfer of gas will cease and backward flow of gas will be automatically prevented.

For the purpose of preventing any dirt, dust or large particles from passing from the main gas supply tank into the breathing apparatus the inner end of the check valve body is provided with a screen 69 which separates such material from the gas and holds it back in the body of this valve until the apparatus can be cleaned, thereby

preventing such material from interfering with the proper functioning of the parts with which the gas comes in contact as well as preventing the aviator from inhaling the same. In the preferred construction the screen 69 is seated on a shoulder at the inner end of the socket in the partition body which receives the body 23 of the main check valve and is held thereagainst by a spring 169 interposed between this screen and the inner end of the valve body 23, as shown in Fig. 5.

In order to enable the aviator or other user of this apparatus to observe the pressure at which the gas is being supplied to the apparatus, gage means are provided which comprise a pressure responsive gage 70 which may be of any suitable construction and which is mounted on the upper side of the case of the apparatus so that the aviator can conveniently read the indicator of the gage. The mechanism of the gage may be of the usual pressure responsive type now in common use and a branch tube 71 may be employed which connects the passage 66 adjacent to the check valve body 23 with the inner part of the gage, as shown in Figs. 2 and 5. This branch tube consists preferably of flexible metal so that the same can be bent for convenience in assembling and disassembling the parts with which the gage is associated. For the purpose of preventing excess pressure in the receiving chamber 16 a safety or automatic blow-off valve 72 is provided whereby gas will be permitted to escape from this receiving chamber to the delivery chamber 18 in case the pressure within the receiving chamber rises above a predetermined normal due to leakage. This safety valve may be of usual and well known construction, such as the spring loaded safety valves now in common use, and the same may be located in any available part of the apparatus but, as shown in Figs. 2, 5 and 6, the same is arranged in an opening formed in the upper part of the partition body 19 and extending from the receiving chamber to the delivery chamber. When therefore an excessively high pressure exists in the receiving chamber the safety valve opens automatically and permits sufficient gas to escape to the delivery chamber as will reduce the pressure in the receiving chamber to the desired point.

The oxygen is withdrawn from the delivery chamber by inhalation of the aviator through the medium of an inhaling apparatus or mask which is applied to the face of the aviator and which is provided with an inhaling tube 73 of the usual character. When the aviator wishes to inhale oxygen from the delivery chamber the inlet or nozzle 74 of this inhaling apparatus is inserted in a tubular socket 75 which is formed in the bore of a bushing or sleeve 76 mounted on the case of the breathing apparatus. In its preferred form this sleeve is of cylindrical form and secured in a correspondingly shaped opening 77 in the top of the housing by a set screw 78. A gasket 79 is clamped between this case and a shoulder 80 on this sleeve for producing an air-tight joint between the same. When the breathing apparatus is not in use the outlet opening in this sleeve is closed by a lid 81 which is connected at one part of its edge to the adjacent part of the sleeve by means of a hinge consisting preferably of a pintle 82 passing through companion pivot lugs 55 arranged on corresponding edge portions of the lid 81 and the sleeve 76. This lid is yieldingly held in a closed position by a helical spring 83 surrounding the pintle of this hinge and bear-

ing at its opposite ends against the lid and the adjacent part of this sleeve.

In order to use the breathing apparatus the lid is lifted and the nozzle of the inhaler inserted into the gas outlet of the delivery chamber and during this time the lid is held by the spring 83 against the inhaling tube 73, as shown in Fig. 6, and whenever the inhaling tube is withdrawn this spring automatically closes the lid so as to retain the oxygen in the delivery chamber, and prevent any dirt or particles from falling into the unit while the same is not in use.

As depletion of oxygen occurs in the delivery chamber the volume of oxygen withdrawn is automatically replenished by an oxygen restoring means which form a part of the present improvement and which, in the preferred form, are constructed as follows:

The numeral 84 represents a gas restoring passage formed in the partition body 19 and extending from the receiving chamber 16 to the delivery chamber. This restoring passage is controlled by a demand or control valve mechanism which responds to the suction or vacuum effect produced in the delivery chamber by the inhalation of the aviator so that when the aviator withdraws gas from the delivery chamber a corresponding amount of gas will be automatically permitted to flow from the receiving chamber 16 into the delivery chamber 18 and when the withdrawal of gas from the delivery chamber ceases then the flow of gas from the receiving chamber to the delivery chamber will be automatically arrested.

This demand or restoring valve mechanism includes a valve plate 85 which extends across the outlet end of the restoring passage 84 and is secured to the partition by means of screws 86 threaded into the partition body and having washers 87 overlapping this valve plate, as shown in Fig. 4. A gasket 88 is clamped between the margin of this valve plate and the partition body to form an air-tight joint between these members. On its inner side the valve plate is provided with an annular valve seat 89, and its central part has a valve stem guide opening 90. Between the latter and the valve seat 89 this plate has a plurality of gas ports or openings 91. On its outer side the valve plate has a cavity forming a spring seat 92. The numeral 93 represents a valve having preferably the form of a disk made of rubber or the like and secured in a cup-shaped head 94 of metal. The numeral 95 represents a valve stem which has its inner part secured to the head 94 and passing through the valve 93 and the central opening in the valve plate while the outer part of this valve stem projects outwardly into the central part of the delivery chamber 18. The valve 93 is yieldingly held by a return spring 96 in a position in which this valve engages all parts of the seat 89 and thus closes the restoring passage 84. This spring preferably has the form of a helical cone which surrounds the inner part of the stem 95 and has its large inner end engaging the seat 92 while its small outer end is secured to the valve stem 95, as shown in Fig. 6. In the closed position of the controlling or restoring valve 93 the stem 95 is arranged axially in line with the center of the valve seat 89. For securing compactness the partition body 19 is provided with a recess 97 on its outer side in which the valve plate 85, the restoring valve and the inner or rear parts of the valve stem and return spring 96 are lo-

cated. These parts are also so arranged that the axes of the same are inclined and the valve stem projects upwardly and outwardly relative to the lower part of the partition body, as shown in Fig. 6. Upon moving the valve stem 95 laterally inward relative to the axis of the valve seat 89, the valve 93 is rocked so that it turns with the outer part of its edge as a fulcrum on the outer part of the seat 89 and the diametrically opposite inner part of this valve is moved away from its seat, thereby uncovering the outlet of the restoring passage 84 and permitting gas to pass from the receiving chamber to the delivery chamber. During this tilting movement of the valve 93 and valve stem 95, the return spring 96 is distorted so that when the valve stem is released the resilience of the spring 96 again returns the valve stem and restoring valve so that this stem is arranged in its central or normal position and the restoring valve is closed.

For the purpose of causing withdrawal of gas from the delivery chamber to automatically tilt the restoring valve and open the same a movable wall is provided which moves inwardly in response to atmospheric pressure against its outer side while a vacuum is created on the inner side thereof by inhalation of the aviator and thereby actuates the valve stem 95 for opening the restoring valve. This movable wall preferably has the form of a flexible diaphragm 98 of thin rubber, impervious silk or the like which is arranged within the cover 13 and extends across the open end 99 in the corresponding side of the case or housing so that this diaphragm forms a wall of the delivery chamber 18. On the central part of the inner side of this diaphragm it is provided with a bearing plate 100 having the form of an outwardly dished disk which bears against the outer end of the valve stem. The flexible diaphragm is detachably secured to the peripheral surface of the case around its opening 99 by lapping the marginal flange 101 of this diaphragm over an annular groove 102 in this peripheral surface and holding this marginal part in said groove by means of an annular retaining member 103 which may consist of a rubber band, as shown in Figs. 2 and 6, or by a cord, a split spring ring or the like.

The cover or front wall 13 of the main housing is provided with a plurality of vent openings 104 to permit the external air to act on the outer side of the diaphragm.

In order to cause the gas as it issues from the restoring passage 84 to be deflected upwardly toward the outlet tube 75 of the delivery chamber, a deflector 105 is secured in an upright position on the lower part of the partition and across the space along the outer side of the restoring valve, thereby preventing this stream of gas, as it issues from the restoring passage 84, from striking the lower part of the diaphragm and interfering with the uniform operation of the same around its entire surface. This deflector is preferably high enough to cover all of this control valve mechanism except the upper part of the valve stem 95 and is provided with a notch or slot 205 through which this stem projects outwardly, as shown in Figs. 2 and 6.

In using this apparatus the aviator attaches the same to the breast portion of his harness by means of the clip 15 and then temporarily connects the filling valve body 23 with the hose 63 leading to the main gas supply tank and permits gas to flow from this tank into the bottle 17 and the receiving chamber 16 until the required pres-

sure has been attained in accordance with the showing on the pressure gage or indicator 70. The aviator then detaches the hose from the filling valve 23 which leaves him free to move about the plane and operate the same.

Upon reaching the higher altitudes in his flight and when the air becomes rarified or deficient in oxygen the aviator inserts the nozzle 73 of his inhaling tube into the outlet 75 of the delivery chamber and then, by inhaling, withdraws oxygen from the delivery chamber to the interior of the aviator's mask. While oxygen is withdrawn by inhalation from the delivery chamber 18 the latter is replenished from the receiving chamber 16 in the same measure as the aviator's demand or necessity requires by the automatic opening of the restoring or control valve 93 which results from the inward movement of the diaphragm 100 under atmospheric pressure so long as the aviator continues to inhale oxygen from the delivery chamber. When this inhalation ceases the recoil of the spring 96 causes the valve stem 95 to push the diaphragm outwardly and to close the controlling or restoring valve 93, thereby stopping the further flow of oxygen gas from the receiving chamber to the delivery chamber. This operation is repeated as often as is found necessary to maintain the aviator in safe and comfortable condition.

As a whole this apparatus is very light in weight, yet strong in construction and very sensitive in its operation and reliably furnishes the aviator with oxygen as required.

I claim as my invention:

1. A breathing apparatus comprising a case having side and bottom openings, a body secured to the inner side of said case and having a neck projecting outwardly through one of said openings and provided with a receiving chamber and a plurality of intercommunicating conduits one of which is arranged in said neck, another one adapted to communicate with said receiving chamber and another extending to the side of said body in line with the other opening in the case, an oxygen bottle connected with said neck, a check valve having a body arranged in the last mentioned opening of said case and adapted to connect and disconnect the conduit in the adjacent part of the body with a source of oxygen, and a reducing valve mechanism for controlling the flow of oxygen from said conduits into said receiving chamber.

2. A breathing apparatus comprising a case having side and bottom openings, a body secured to the inner side of said case and having a neck projecting outwardly through one of said openings and provided with a receiving chamber and a plurality of intercommunicating conduits one of which is arranged in said neck, another one adapted to communicate with said receiving chamber and another extending to the side of said body in line with the other opening in the case, an oxygen bottle connected with said neck,

a check valve having a body arranged in the last mentioned opening of said case and adapted to connect and disconnect the conduit in the adjacent part of the body with a source of oxygen, a reducing valve mechanism for controlling the flow of oxygen from said conduits into said receiving chamber, and a screen extending across the passage in said check valve body.

3. A breathing apparatus comprising a case having side and bottom openings, a body secured to the inner side of said case and provided with a receiving chamber and a plurality of intercommunicating conduits, one of which is in line with said bottom opening in the case and another being in line with the side opening thereof, an oxygen bottle connected with the conduit which is in line with said bottom opening, check valve means adapted to connect and disconnect this conduit in line with the side opening with a source of oxygen, and a reducing valve mechanism for controlling the flow of oxygen from said conduits into said receiving chamber.

4. A breathing apparatus comprising a case having an outlet in its top, an opening in its bottom and an opening in its side, a body secured to the inner side of the case and forming between the body and the case a delivery chamber communicating with said outlet and also containing a receiving chamber, a bottom conduit in line with said bottom opening and a side conduit communicating with said bottom conduit and arranged in line with said side opening, an oxygen bottle connected with said bottom conduit, a check valve mechanism connecting said side conduit with a source of oxygen, a regulating diaphragm forming a wall of said receiving chamber, and a pressure reducing valve mechanism controlling the flow of oxygen from said conduits to said receiving chamber and actuated by said regulating diaphragm.

5. A breathing apparatus comprising a case having an outlet in its top, an opening in its bottom and an opening in its side, a body secured to the inner side of the case and forming between the body and the case a delivery chamber communicating with said outlet and also containing a receiving chamber, a bottom conduit in line with said bottom opening and a side conduit communicating with said bottom conduit and arranged in line with said side opening, an oxygen bottle connected with said bottom conduit, a check valve mechanism connecting said side conduit with a source of oxygen, a regulating diaphragm forming a wall of said receiving chamber, a pressure reducing valve mechanism controlling the flow of oxygen from said conduits to said receiving chamber and actuated by said regulating diaphragm, and a demand valve mechanism which controls the flow of oxygen from the receiving chamber to said delivery chamber and which is responsive to variations in pressure in said delivery chamber.

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